Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 23849

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Fifth Semester

Mechanical Engineering

ME 2301 – THERMAL ENGINEERING

(Common to Mechanical Engineering (Sandwich))

(Regulations 2008)

(Also common to PTME 2301 – Thermal Engineering for B.E. (Part-Time) Fourth Semester – Mechanical Engineering – Regulations 2009)

Time : Three hours Maximum : 100 marks

(Steam tables, Refrigeration tables, Psychrometry charts and Mollier diagram can be used)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Name any four assumptions made for air standard cycle analysis.
2. Sketch the dual cycle on p-V and T-s co-ordinates.
3. List the main parts of a lubrication system.
4. What is known as pre ignition? State its effect.
5. Define critical pressure ratio. Calculate the value of critical pressure ratio for saturated and supersaturated steam.
6. What is the effect of supersaturated flow in steam nozzle?
7. List the effects of inter-cooling in a multi stage compression process.
8. Give the classification of compressor based on movement of piston.
9. What is the difference between Wet compression and Dry compression?
10. Enumerate the components of cooling load estimate.

PART B — (5 × 16 = 80 marks)

11. (a) In an engine working on Dual cycle, the temperature and pressure at the beginning of the cycle are 90°C and 1 bar respectively. The compression ratio is 9. The maximum pressure is limited to 68 bar and total heat supplied per kg of air is 1750 kJ. Determine :

(i) Pressure and temperature at all salient points

(ii) Air standard efficiency

(iii) Mean effective pressure. (16)

Or

(b) (i) Consider an air standard cycle in which the air enters the compressor at 1 bar and 20°C. The pressure of air leaving the compressor is 3.5 bar and the temperature at turbine inlet is 600°C.

Determine per kg of air:

(1) Efficiency of the cycle. (3)

(2) Heat supplied to air (2)

(3) Work available at the shaft. (2)

(4) Heat rejected in the cooler, and (3)

(5) Temperature of air leaving the turbine. (3)

For air $\gamma = 1.4$ and $C_p = 1.005$ kJ/kg K.

(ii) The efficiency of an Otto cycle is 60% and $\gamma = 1.5$. What is the compression ratio? . (3)

12. (a) Discuss the construction and working principle of a four stroke engine with sketch. (16)

Or

(b) Explain the construction and working principle of Battery coil ignition system with neat sketch. (16)

13. (a) (i) Mention the types of nozzles you know. Where are these used? (8)

(ii) From first principles, prove that maximum discharge per unit area in a steam nozzle at the throat is given by the expression (8)

$$\frac{m_{max}}{A} = \left[2\left(\frac{p_1}{v_1}\right)\left(\frac{2}{n+1}\right)^{\frac{n+1}{n-1}} \right]^{1/2}.$$

Or

(b) The following data relate to a single stage impulse turbine :

Steam velocity = 600 m/s;

Blade speed = 250 m/s;

Nozzle angle = 20°;

Blade outlet angle = 25°;

Neglecting the effect of friction, calculate the work developed by the turbine for the steam flow rate of 20 kg/s. Also calculate the axial thrust on the bearings.

14. (a) A single-acting two-stage air compressor deals with 4 m^3/min of air at 1.013 bar and 15°C with a speed of 250 rpm. The delivery pressure is 80 bar. Assuming complete intercooling. Find the minimum power required by the compressor and the bore and stroke of the compressor. Assume a piston speed of 3 m/s, mechanical efficiency of 75% and volumetric efficiency of 80% per stage. Assume the polytropic index of compression in both the stages to be n = 1.25 and neglect clearance. (16)

Or

(b) Explain with neat sketch the construction and working of Roots blower with two lobe and three lobe rotor and Vane type compressor. (16)

15. (a) (i) What are the properties of a good refrigerant? (4)

(ii) An Ammonia refrigerator produces 30 tons of ice at 0°C in a day of 24 hours. The temperature range in the compressor is from 25° C to –15°C. The vapour is dry saturated at the end of compression. Assume a COP of 60% of Theoretical value. Calculate the power required to drive the compressor. Assume latent heat of ice is 335kJ/kg. For properties of NH_3, refer the table below. (12)

Temperature (°C)	h_f	h_g	S_f	S_g
	kJ/kg	kJ/kg	kJ/kg	kJ/kg
25	298.9	1465.8	1.124	5.039
–15	112.34	1426.5	0.4572	5.549

Or

(b) (i) An office is to be air-conditioned for 50 staff when the outdoor conditions are 30°C DBT and 75% RH if the quantity of air supplied is 0.4m^3/min/person find the following:

(1) Capacity of the cooling coil in tones of refrigeration (4)

(2) Capacity of the heating coil in kW (4)

(3) Amount of water vapour removed per hour. (4)

Assume that required air inlet conditions are 20°C DBT and 60% RH. Air is conditioned first by cooling and dehumidifying and then by heating.

(ii) Describe the factors that affect human comfort. (4)